Defining and Classifying Infrastructural Contestation

Giovanopoulos, Christos; Kallianos, Yannis; Athanasiadis, Ioannis N.; Dalakoglou, Dimitris

published in
Environmental Software Systems. Data Science in Action
2020

DOI (link to publisher)
10.1007/978-3-030-39815-6_4

document version
Publisher's PDF, also known as Version of record

Defining and Classifying Infrastructural Contestation: Towards a Synergy Between Anthropology and Data Science

Christos Giovanopoulos[1(✉)], Yannis Kallianos[1], Ioannis N. Athanasiadis[2], and Dimitris Dalakoglou[1(✉)]

[1] Vrije Universiteit Amsterdam, Amsterdam, The Netherlands
{c.giovamopoulos,d.dalakoglou}@vu.nl
[2] Wageningen University and Research, Wageningen, The Netherlands

Abstract. The last decade infrastructure systems have been under strain around the globe. The 2008 financial crisis, the so-called fourth industrial revolution, ongoing urbanisation and climate change have contributed to the emergence of an infrastructural crisis that has been labelled as infrastructural gap. During this period, infrastructure systems have increasingly become sites of public contestation with significant effects on their operation and governance. At stake has been the issues of access to infrastructure, their social and environmental consequences and the 'modern ideal' embodied in the design of those socio-technical systems. With this paper we apply a cross-disciplinary methodology in order to document and define the practices of this new wave of infrastructural contestation, taking Greece in the 2008–2017 period as the case study. The synthesis of quantitative and qualitative datasets with ethnographic knowledge help us, furthermore, to record tendencies and patterns in the ongoing phenomenon of infrastructural contestation (This study is part of infra-demos project (www.infrademos.net), which is funded by a VIDI grant awarded by the Dutch Organisation of Science, PI: Prof. Dimitris Dalakoglou, Dept. of Social and Cultural Anthropology, Vrije Universiteit Amsterdam).

Keywords: Infrastructural contestation · Infrastructural gap · Anthropology · Data sciences

1 Introduction

The last decade infrastructures have been increasingly noticeable as the terrain of socio-political contestation. Economic crisis, disruptive technologies and ongoing urban expansion - among other reasons - challenge the capacities of even the 'developed economies', to sustain their pre-crisis level of infrastructural provisions. This phenomenon, which has been labelled infrastructural gap (Authers 2015; Dalakoglou 2016; ODI 2016), challenges the modernist ideal of infrastructure development and questions its concomitant model of infrastructural governance. The role of infrastructure systems as safeguards of unhindered economic growth and social cohesion is at stake and has been contested by various movements in diverse forms. A recent example of such contestation has been the Yellow Vest protests in France that were concerned

Published by Springer Nature Switzerland AG 2020
I. N. Athanasiadis et al. (Eds.): ISESS 2020, IFIP AICT 554, pp. 1–16, 2020.
https://doi.org/10.1007/978-3-030-39815-6_4

initially with access to automobility, heating, and hydrocarbon-based energy. That movement, besides contesting the infrastructural and environmental policies of the French government, signified the break-up of the social contract between polity and citizenry that is facilitated by these infrastructural provisions.

This paper aims (A) to define infrastructural contestation, to create a typology of the phenomenon and to document its diversity and its scale and (B) to show trends and patterns within infrastructural contestation, with Greece as the case study. In order to achieve this, we have compiled datasets of events of grassroots contestation and socio-political struggles related to infrastructures during the 2008–2017 period. In the context of the infra-demos project, which seeks to critically understand the relationship between infrastructures, democracy and civil participation, we analyse these struggles both qualitatively and quantitatively using ethnographically embedded knowledge and digital tools. The latter enriches the affordances and capacities of the ethnographically acquired knowledge by making explicit quantitative correlations. The analysis and visualisation of large data-sets related to infrastructural contestation allow us to conceptualise the various representations of contestation. Moreover, this ongoing synergy between data science and anthropology, although a work in progress, enables us to detect processes towards a more active citizen engagement with infrastructure.

2 The Case Study and Beyond

The global financial crisis had sweeping consequences for infrastructural sustainability and provision within Europe. Increased austerity in public spending as well as privatisation of public assets affected the governance, maintenance and materialities of hard infrastructures[1]. The consequences for soft infrastructures (Filion and Keil, 2016) are even more evident, with reductions in funding for social provision and welfare services (Dalakoglou 2016). As such, the crisis – paired with neoliberal policies – has challenged the role of infrastructures in 'forming the base on which to operate modern economic and social systems' (Larkin 2013: 330).

Within that context while Greece may have been the most extreme case of crisis-stricken country in the EU, it is far from being unique (Dalakoglou and Agelopoulos 2018). The volatile financial recovery and the ongoing political uncertainty across the EU combined with the permeation and effects of disruptive technologies around the globe, have upset the foundations and legitimacy of the dominant infrastructural model. At the same time, infrastructural contestation has emerged as one of the main socio-political phenomena through which austerity, neoliberal policies, environmental risks and state legitimisation have been challenged.

Roads and other transport networks, water and sewage systems, communication and electricity networks, as much as welfare and state governance infrastructures have been subject to social dispute and conflicts. In addition to the aforementioned Yellow Vest protest against the allegedly pro-environment fuel tax and access to auto-mobility,

[1] Between 2006 and 2013 the total drop in the value of infrastructure deals was 80% (Linklaters 2014: 8).

heating etc. in France (2018–19), one can also mention the dynamic protests against the increase in public transport fares in Chile (2019), the water charges battle in Ireland (2015–16), the re-municipalisation of water systems (e.g. Paris 2010, Berlin 2013, Budapest 2012 and many more EU cities), the ongoing No-TAV movement in north Italy, struggles against the construction or expansion of airports (ZAD, France; Gatwick, UK) or for the utilization of former airports (Tempelhof, Berlin).

Making explicit the multifarious ways in which similar socio-political mobilisations contested infrastructure systems and flows in Greece during the same period provides insights and a method that can inform research in different frameworks. Those movements have rendered the infrastructural domain as one of the most important public sites of civil participation. On the one hand, they made visible power relations embedded in the technologies, governance and distribution of infrastructure systems, allowing their re-conceptualisation. On the other hand, the diverse (traditional and novel) modes of engagement with infrastructural systems arguably underline the potential for emerging, innovative and democratic forms of infrastructure participation.

3 Mapping Infrastructural Contestation

Our engagement with previous studies on the infrastructural gap and political mobilisations (Crisis-scape.net 2014; Dalakoglou and Kallianos 2014, 2018; Giovanopoulos and Dalakoglou 2011) and pilot ethnographic fieldwork on sites where infrastructures were contested (solidarity schools and clinics, waste management, energy communities) provided us with an empirical understanding of the significance and wider dynamic of infrastructural contestation. Thus, before proceeding to more precise and longer-term ethnographic fieldwork the need for systematic documentation of the phenomenon, its taxonomies and scales and by extension for a more precise definition of its content in practice became explicit to us.

Our mapping focuses on the grassroots aspect of infrastructure contestation and is composed by four dimensions: (1) a description of instances of socio-political antagonism in regard to infrastructure; (2) the different types of those events according to their means of struggle/form of action; (3) the infrastructural fields those conflicts regard; and (4) the mode of infrastructure contestation each of the events relates to. Our aim has been to depict the realm of socio-technological interventions from below and highlight comparisons between them in order to visually explore patterns and draw some preliminary conclusions.

3.1 Method

In order to collect and digitise our dataset, we followed seven stages.

1. By building on thick and deep datasets acquired from our previous and pilot studies we created a broad but systematic timeline of socio-political conflicts that took place between 2008 and 2017. We did so according to their documentation in communication hubs (online media) of social movements. This initial timeline operated as guideline in outlining the two next steps.

2. While we confirmed the high degree of conflicts related to infrastructure at this point our research lacked a definition of the infrastructural fields at play. Thus we proceeded in their classification to specific categories (Table 1). In order to do so we drew from the report *Infrastructure for the 21st Century: Framework for a Research Agenda* by the National Research Council (1987) for the US Committee on Infrastructure Innovation, and from the definition provided by the Greek Centre for the Security Studies (Ministry of Public Order and Citizen Protection) according to the EU directive 2008/114/EC about 'European critical infrastructure' (Official Government Gazette 2011).
3. Next, we separated from the broader timeline of socio-political contestation those events that occurred around and were related to, to a greater or lesser degree, the infrastructural fields that we defined. Thus we formed the initial chronological line-up of instances of infrastructural contestation which constitutes the first dimension of our mapping.
4. We proceeded then in defining the second dimension of our mapping. This regarded the variation of the struggles and mobilisations related to infrastructures according to the means and kind of practices they employed. We classified the events in six categories: i. strikes & protests, ii. civil disobedience campaigns, iii. community struggles, iv. (infrastructure) self-management or recuperation, v. institutional and legal interventions and vi. generative endeavours linked to infrastructuring attempts. Such categories are not mutually exclusive. An event may involve more than one type of action. Analytically they are important because they indicate the connection between types of socio-political and infrastructural contestation. Most significantly they point out to the subjects and processes that are more prone to contest critically infrastructure systems. In addition, we drew a last category to include 'general events', mainly general strikes, that interacted with more specific and targeted movements around infrastructure.
5. The following step was to classify the recorded events according to the different ways in which they engage with and contest infrastructure. Thus, we defined a typology of infrastructure contestation (see Sect. 4 below), which forms the third dimension of our datasets. Central to the definition process has been the degree with which movements, forms of struggle and demands problematise, or not, the existing infrastructure paradigm.
6. Building on these initial findings and definitions we continued with a more thorough, focused and detailed search of events of infrastructural contestation. Our aim was to cover and map to the largest possible degree movements, campaigns and citizen initiatives which engaged with infrastructural contestation. This effort resulted in a list of 880 events.
7. The last part included the revisiting of our taxonomy of infrastructural contestation. Considering issues that were raised by the larger volume and variety of events and types of action that challenged the established infrastructure arrangements, we refined our definitions and typology of infrastructural contestation (see Sect. 4).

Table 1. Infrastructure type categorisation.

Infrastructure type	Subcategories
Transport & mobility	Airways/airports Bridges & canals Public transport (metro, bus, trains, etc.) Railways Roads Ports/sea transport
Energy	Gas pipelines, storage, distribution Oil production, storage, distribution Power-plants (oil, coalmines etc.) Power-grid Renewable energy power-plants (air, solar, water)
Water	Sewage network Water supply network Irrigation network Dams
Waste	Solid waste Hazardous waste Landfill sites Recycling plants
Communication & information systems	Public broadcasting services Telecommunication networks (analogue and digital) Media (press, radio, TV, digital)
Welfare infrastructures	Health care (hospitals, etc.) Social security (insurance – pension system) Education (schools, universities, etc.) Housing (temporary shelter) Recreation (parks, coastlines, public spaces, etc.)

3.2 Sources

The collection and composition of the datasets was one of the most challenging parts of the process. This was due to the magnitude of mobilisations that occurred in this period, due to the lack of any consistent recording of socio-political struggles[2] in Greece and due to the informal status of many of these grassroots movements unlike elsewhere in Europe (Institute of Citizen Studies 2016). While our mapping of events of infrastructural contestation is by no means exhaustive, we attempted a double task. First, to certify the validity of information regarding the events we documented. Second, to achieve a degree of representativeness in relation to the array of movements that

[2] Even the most organised and institutionalised social movements, such as the General Confederation of Trade-Unions of Greece (GSEE), kept records of the labour movement activities only between 2011–2017.

emerged around infrastructure during this period. In order to achieve this, we proceeded as follows:

1. By combining our initial mapping of socio-political antagonism and our ethnographically acquired knowledge we made a list of the movements and campaigns related to infrastructural contestation. This assisted a more focused research for, and use of, sources.
2. We looked for existing datasets that cover large parts of grassroots encounters with infrastructure. Those datasets include: the annual report on strikes and labour mobilisations of the Research Institute of the General Confederation of Greek Workers (INE-GSEE) published between 2011–2017 and unprocessed archival material for the 2008–2009 period which were made available to us; raw data of Prof. Serntedakis and Koufidi's research on "Conflictual and electoral cycle in crisis-ridden Greece" (2018) which cover the years 2009–2013 were kindly shared with us by the authors. From those datasets we retrieved the vast majority of infrastructural events related to labour strikes and protests.
3. In order to pin down the diffused activity of informal movements on infrastructural fields we scanned online hubs of social movements (athens.indymedia.org and kinimatorama.net) and hubs of the alternative and social solidarity economy (enallaktikos.gr and solidarity4all.gr). Through these sources we documented specific actions of grassroots infrastructural contestation and we identified struggles and initiatives which we then confirmed and explored more via other avenues.
4. The online media hubs (webpages and blogs) of movements and campaigns, 12 in total, and the online outlets and social media of citizens' initiatives which engaged in infrastructural contestation, 73 in total, have also been a significant source. These sources covered a big portion of campaigns (e.g. against mobile phone towers, road tolls and public transport price-hikes), of specific struggles related to infrastructure (e.g. against landfill construction in the town of Keratea, anti-privatisation struggles, or against mergers of public hospitals and schools), as well as of initiatives that created their own alternative infrastructures (e.g. solidarity clinics and schools).
5. Lastly, we resorted to an open internet search in order to retrieve information for specific events of infrastructural contestation that we had already identified. These sources included articles from the online editions of 11 newspapers with nationwide distribution, 32 regional and local media outlets, 9 online media sources, 3 special interest media, and 8 alternative media sources. In total 63 different sources.

While we acknowledge that our mapping is not exhaustive, by collecting and cross-checking between these sources we believe that our dataset offers a representative sample of the events and features of infrastructural contestation. However, we should also be attentive to unbalances between forms of infrastructural contestation that may be linked to the choice, or lack, of sources. The systematic recording of labour struggles by the trade unions' institute INE-GSEE for example may have contributed to an over-representation of infrastructural contestation related to labour issues and working conditions. We tried to counter such unevenness by performing a meticulous documentation of the informal and decentralised movements. We did this by using alternative media, and mainly their own sources, to record infrastructure related actions. In any case, judging by our findings, any such unbalance does not contradict our initial

hypotheses for the increasing importance of infrastructural contestation, and for the growing tendency towards participation and reconfiguration of the existing infrastructural arrangements.

4 Modes of Infrastructural Contestation

Suggesting a typology of the modes of infrastructural contestation has not only been the most demanding task but also critical for the conceptualisation of infrastructural contestation. In order to explore the diverse characteristics that defined infrastructural contestation during the examined period we organised a typology based on the following criteria:

a. the ability to render infrastructure space as a site of socio-political antagonism,
b. the relationship between the expressed demands or actions of a movement, community or public and the infrastructure's function or transformation,
c. the form that this contestation has taken in relation to the operation of infrastructure (disruption, remodification, alternative use, innovation, etc.).

Based on the facts gathered so far, and on ethnographic affinity and knowledge we argue that we encountered at least six modes of infrastructural contestation.

4.1 Contestation of Labour and Working Conditions

Industrial actions in defense of labour rights and income (social security, pensions etc.) and resisting the deregulation of the labour market - which often involves technological changes - compose this type of contestation. Although most times this type does not explicitly refer to infrastructure per se, nevertheless it is central to the disruption (and efficacy) of infrastructural function and provision. According to Pasternak and Dafnos (2018: 740) '[T]he timely circulation of goods, services, information, resources, and energy through territory is critical to capitalism today, rendering acute the problem of blockades and resource extraction stoppages for the state'. Moreover, the attempts to restrict this disruptive power held by infrastructure employees (even by manual non-specialised workers) has often led to infrastructural 'innovation' (automation, robotics etc.).

4.2 Contestation for the Right to Access

This type concerns struggles for a fairer distribution of, and access to, infrastructure networks that are fundamental in sustaining everyday life (water, energy, transport etc.). This mode may interweave with demands for public investment on infrastructure development. It also relates to acts of civil disobedience for access to infrastructure (e.g. clandestine power connections) or with resisting unfair payments for infrastructural services (e.g. refusal to pay transport fares or road-tolls). Such actions have a very direct result in asserting the right to infrastructural use. However, while contestation over access accentuates the injustices in the distribution of infrastructure networks it does not always prompt a questioning of the infrastructural model. Yet, in specific

contexts, such contestation type may cause growing financial leakages in infrastructural systems (power-grid, water supply, road system etc.) and thus enforce changes in the governance and operational mode of the infrastructure at stake.

4.3 Ownership and Governance Contestation

Modes of ownership and governance are among the most contested issues when it comes to infrastructure. The primarily state-funded and run infrastructural model of modernity has been under attack from neoliberal policies and governance the last 50 years (Graham and Marvin 2001), yet, the defense of infrastructures as public assets constitutes one of the most prominent types of infrastructural contestation still. Anti-privatisation struggles compose the majority of such kind of contestation and occurred in most of the large infrastructural systems in Greece (telecommunications, ports, energy etc.). Most of the times they blend with other modes of infrastructural contestation, usually labour strikes or struggles for the re-municipalisation of infrastructural provisions (e.g. water).

4.4 Contesting Infrastructural Effects

Here contestation usually concerns acts by local communities and movements against the social, environmental and financial effects of infrastructural development in a vicinity. Mobilisations against waste landfills, river dams, mobile phone towers, and industrial scale air-turbines are some examples of this kind of contestation. While such movements develop, largely, a critique of the top down developmental model in situ (within a local context), it is less often the case to see them moving on a wider critique of the infrastructure model itself. In addition, there are cases that refusal to infrastructural development has been associated with maintaining the local, traditional infrastructure and use (or disuse) of natural resources. However, those rebuffs should not be easily classified as a Not In My Back Yard approach, since they inform a critique of a wider economic and political framework of governance. There are examples (e.g. waste management) where movements and communities proceeded from denial to form their own proposals for alternative waste infrastructure system.

4.5 Contestation as Remodification of Infrastructure

Such form of contestation regards numerous collective and individual, but widespread, everyday uses of infrastructural systems that prompt their remodification. It involves cases in which a specific infrastructure is used by the public for purposes other than the ones which it was initially designed for (Filion and Keil 2016). In this way a certain level of re-purposing of the specific infrastructure takes place. Most of these cases unfold at the everyday molecular level. However, this type of contestation may also include collective attempts to transform the function and use of an infrastructure. Cases where public ‘brown fields’ were converted into parks, self-managed recreational spaces or urban-farms are some examples of contestation as remodification in Greece.

4.6 Transfigurative Contestation

This last type includes movements and attempts which experiment, design or develop alternatives to the dominant paradigm infrastructure with regard to engagement in acts of infrastructuring. Transfigurative contestation does not concern only attempts for more inclusive and equal redistribution of infrastructural provisions. It regards experimentation with infrastructure prototypes which aim to organise and facilitate processes of social transformation. In that sense it refers 'to infrastructure' as verb and not as a noun. It expands 'the right to infrastructure' from merely a meaning of 'access to' to a concept that claims the right to create infrastructure (Jiménez 2014). Thus, it opens up the notion of infrastructural contestation to participatory experiments of design in a process of democratisation (and commoning) of infrastructural systems. Examples of transfigurative contestation in Greece include self-organised solidarity clinics, solidarity schools, cooperative hydroelectric power-plants and/or renewable energy communities.

Having defined these six types of infrastructural contestation, according to our data and findings, we need to clarify a few points. First they are not mutually exclusive. This typology is proposed for analytical reasons and it aims to unveil how different agencies, interests and publics affect the technologies and operation of infrastructural systems. Thus many acts of socio-political contestation entailed more than one type of infrastructural contestation. More importantly, a particular struggle could evolve and include many different forms or instances of infrastructural contestation.

5 Open Data and Digital Visualisation

We have compiled a dataset that includes about 880 grassroots socio-political encounters with infrastructure, that span from 2008 to 2017. Some events existed in an instant in time (as in the case of one day strikes or one off protests), while others have been assigned a duration that spans across several days (as in the case of the operation of social pharmacies). Thus, events are associated with two dates: a compulsory start date, and an optional end date. However, some repetitive events correspond to long term campaigns (e.g. against the road tolls, or anti-privatisation struggles) but appear as instant events date-wise.

Each event is classified in three dimensions: according to the type of struggles and actions it employed, according to the infrastructural field in which it unfolded and according to the mode of infrastructural contestation it indicates. Each event can be associated with more than one types, fields and modes. Data have been organized in a spreadsheet, and will be published using an open license, on Zenodo.

To visualise the dataset, we have employed the Timeline Storyteller (Brehmer et al. 2017), an open-source expressive visual storytelling environment for presenting timelines in the browser or in Microsoft Power BI. Timeline Storyteller allows us to visualise different aspects of timeline data using a palette of timeline representations, scales and layouts, as well as controls for filtering, highlighting and annotation. The data storytelling approach intends to use quantitative date to convey multiple narrative points, and to explore the process of transforming data into visually shared stories (Lee

et al. 2015). An example timeline is shown in Fig. 1, where the pattern identified shows that in the beginning of the crisis, during the period between 2008–2009, mobilisations mostly concerned 'against infrastructure effects' events, while from 2010 onwards, there was a rise of 'right to access' contestation events.

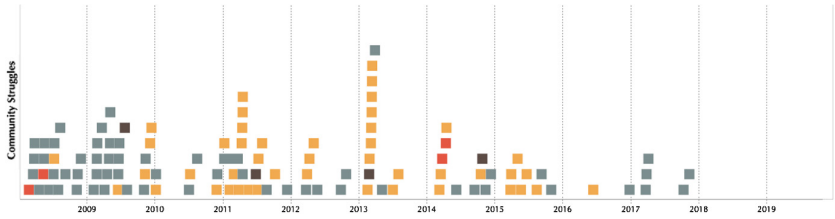

Fig. 1. Timeline of 'community struggle' type of events. (Legend below in Fig. 3)

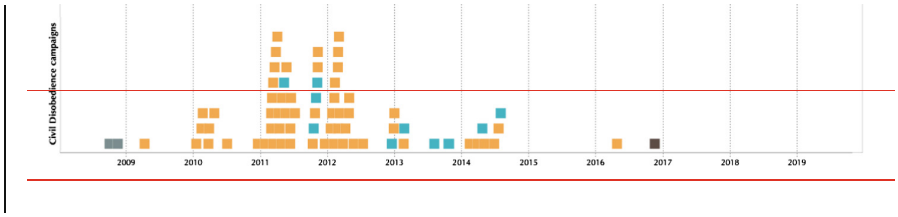

Fig. 2. Timeline of 'civil disobedience' type of events.

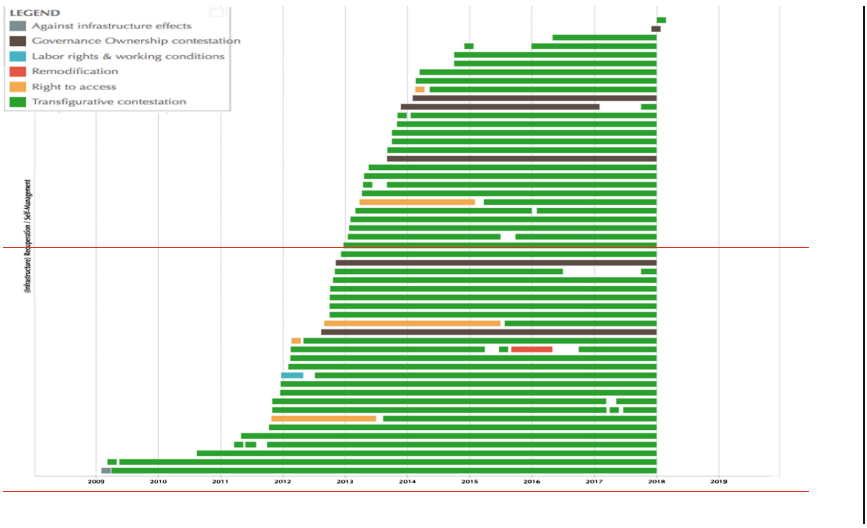

Fig. 3. Timeline of 'self-management/recuperation of infrastructures' type of events.

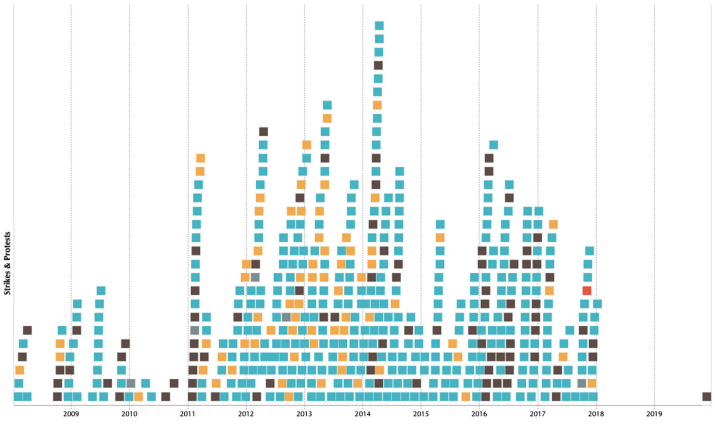

Fig. 4. Timeline of 'strike and protests' type of events

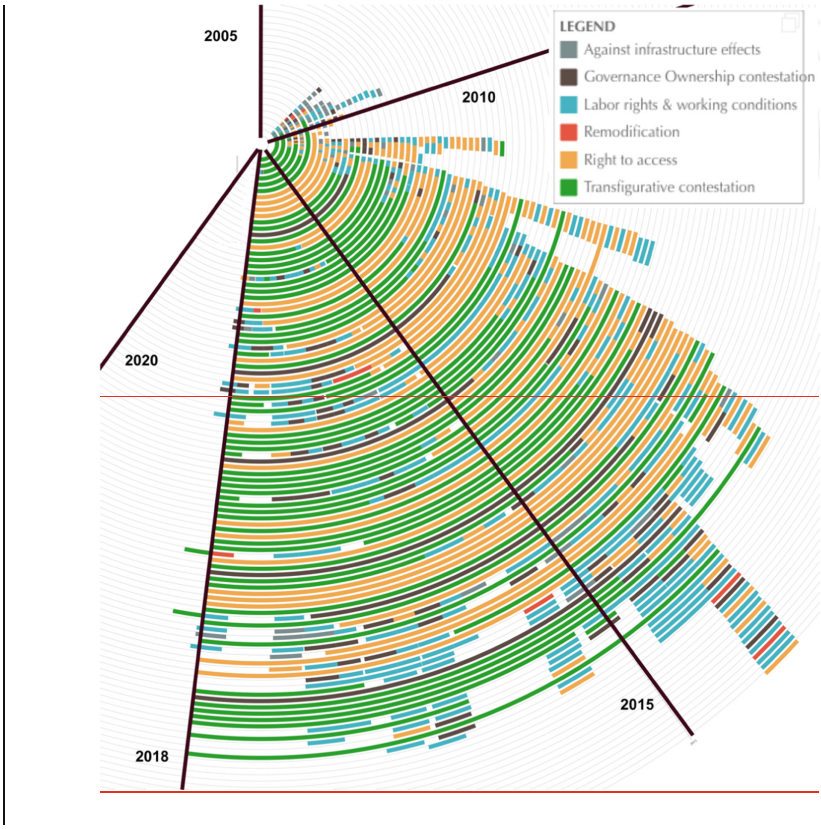

Fig. 5. A screenshot of the visualisation of all events as a round timeline, showing different modes of infrastructural contestation in colour (Color figure online)

6 Preliminary Findings from the Data Visualization

By applying this multi-layered visualisation which spans uninterrupted along a ten-year period (Jan. 2008–Dec. 2017), we were able to compare forms of socio-political interventions around various infrastructure systems with modes of infrastructural contestation. It also made possible the tracing of relations between modes of infrastructural contestation and of emerging trends and patterns. Within this context we can draw five preliminary observations:

1. Looking at the more general trend and mutations of types of contestation we see an explicit tendency from community struggles against infrastructural effects in 2008 and 2009 (Fig. 1), towards civil disobedience in 2011–2012 (Fig. 2) and from there to self-management/recuperation of infrastructures (Fig. 3). While this tendency does not relate to the evolution of a specific event or campaign, it maps a more general trend among various forms of infrastructural contestation. Thus it is revealing of the transformative processes that unfold and of the emerging tendencies for participatory infrastructuring.
2. The majority of the "strikes and protests" type relates predominantly with "labour rights" industrial disputes and to a smaller degree with anti-privatisation struggles (governance & ownership form of infrastructural contestation) and for "right to access" (Fig. 4). This information confirms the weak (and indirect) links of traditional forms of industrial action and the labour movement with transformative infrastructural processes.
3. By taking into account the number of incidents, regularity of appearance and duration of events most present incidents concern labour rights and working conditions, right to access and transfigurative contestation (Fig. 5 and points a. and d. below).
4. The vast majority of cases of transfigurative infrastructural contestation (64 out of 80 events in total, or, 80%) appear on the field of welfare infrastructure. This indicates that it is more likely participatory forms of infrastructuring to occur on the sphere of 'soft infrastructures', which relate to social reproduction and welfare.
5. Almost a tenth of the events documented (84 out of 880) concern "against infrastructural effects" type of contestation. The vast majority of them (75, or, 89%) concern 'community struggles' and largely opposition to the environmental effects of infrastructural development on the fields of waste management, telecommunication (radiation from mobile phone towers) and renewable energy power plants.

7 Remarks and Observations

These initial quantitative observations indicate the favourable areas for more thick description through qualitative enquiry. They also point toward certain directions in order to ethnographically understand better the phenomenon of infrastructural contestation. However, some preliminary points that can be made at this stage by synthesising our mapping and our qualitative thick datasets are:

a. While the majority of contestation involving infrastructural fields concerned labour issues (59%) and took the form of industrial actions and strikes, the most lasting infrastructural effect was exercised by other forms of socio-political contestation. Community struggles and mainly the generation of new infrastructures by the solidarity movement were more closely connected to forms of transfigurative contestation (Fig. 1 and point d. below).
b. Moreover, in regard to infrastructural contestation around labour and working conditions, one should note the non-direct effect of these struggles on infrastructure systems. The discourse of the social agents involved in these incidents lacked a wider critique of the interrelationship between power structures and the operation of the infrastructure within which they acted. The demands of these struggles predominantly concerned opposition to cuts and privatisation of (public) infrastructure. There have, however, been a few interesting exceptions of the labour issue developing into a critique of infrastructure operation, such as the attempt at self-management of the public hospital of Kilkis.
c. By the same token, only some of the cases of infrastructure contestation associated with the right to access or against the effects of infrastructure development seem to develop a critique of the dominant infrastructural model per se. For example, only recently some of the participants in the decade long struggle against solid waste management in Attica, (Fyli, Keratea and Grammatiko) seem to formulate alternative proposals about the infrastructure systems in question. However, such struggles represent processes of active participation in infrastructure planning, even if they just disclaim any infrastructure development.
d. While the number of generative forms of social contestation and of transfigurative paradigms represent a small proportion of instances of infrastructural contestation, they have a much larger time-span and thus transformative capacity. Moreover, qualitative evidence suggests that they include a wider number and variety of actors, users and infrastructural publics (Collier et al. 2016). In this way they often develop significant (and long lasting) participatory infrastructural potential, as is the case with solidarity schools, solidarity clinics and the few self-managed renewable energy power plants.
e. Another significant feature of our method regards the mapping of fluctuations (and interactions) of socio-political mobilisation and incidents of infrastructural contestation. Comparing the two dimensions one notices that they follow a common pattern. Most precisely that in this ten-year crisis period they peak around 2013–2014 and they retreat post-2015. However, a closer look at some parameters, such as time span of an event, provides some interesting qualitative differences regarding the degree that certain forms of mobilisation contest infrastructures and establish accumulatively long-term cases of infrastructural participation. Hence, they constitute examples where novel forms of socio-technical relations and infrastructural citizenship may be incubated.

8 Conclusions

Today infrastructures are increasingly approached as socio-technical systems that shape and are shaped by relationships of power. The post-2008 crisis besides its material consequences, including a serious gap in infrastructure development in Western Europe, has brought to the fore the socio-political role inherent to infrastructure and, thus, contested nature. A feature augmented by technological developments and environmental concerns. As Hill (2017) mentions the design of life-ecosystems in 21st century moves towards something "socially powerful: to shared systems, civic systems." In that context, the emerging digital, interactive and open source infrastructures, have to address an array of concerns around which infrastructural publics and users move and mobilise in both urban and rural environments.

By composing our datasets on infrastructural contestation we were able to visualise, to grasp, and outline the scale of the phenomenon. It enabled us also to determine and classify more precisely the forms that it takes and to make visible a number of quantitative dimensions with significant qualitative impact on the unfolding process. Such visualisation has also pointed out the social and political significance of certain infrastructure fields, trends and patterns, which can direct the ethnography towards specific sites of deeper research and thicker description regarding the qualities of the phenomenon. Moreover, the results can inform decisions regarding the design of new socio-technical systems and solutions able to register concerns (and also utilize knowledge capacities) of 'non-expert' but equally (in-situ) specialised users and communities (Collier et al. 2016). In doing so, 21st century infrastructure systems can not only install (productivity) optimisation sensors but become sentient platforms of the totality of the social and natural life.

The mapping of infrastructural contestation in Greece, despite its focus on grassroots forms of infrastructural contestation – or rather because of it - documented the extended presence of the infrastructural gap that left almost no infrastructural field unaffected. Socio-political tensions have revealed, on the one hand, the infrastructural realm as a contested terrain between a variety of actors and publics; on the other hand, it revealed an increasing number of citizen-led movements that not only fight about or for infrastructure but also over it, namely demand a role to its function and structure. These movements did not refrain from building their own infrastructures where the existing ones failed and thus they should be approached as socio-technical transfigurative attempts.

Within the context of our study infrastructure systems are not only negotiated but emerge as a contested public sphere between differential positions and agencies. At the same time, they also emerge as a plateau of social innovation and participation, as many of our recorded examples demonstrate. Moreover, despite the fluctuations of such transformative endeavors, what it seems established is a permanent process and a variety of practices of infrastructuring, which maintain the potential for a more participatory, democratic and equally distributed infrastructural realm.

A focus on infrastructural contestation thus brings to the fore the variety of societal agents who emerge as constitutive actors in reshaping and recodifying infrastructure, something that challenges the idea that such socio-technical arrangements only become

'visible upon breakdown' (Star and Ruhleder 1996: 113). Events of disruption and blockade of infrastructural flows or acts of contestation that aim towards infrastructural change also manifest, if anything, awareness of both the fragile nature of infrastructure and its critical role in maintaining certain forms of power relations. Hence, when various publics around infrastructures emerge as mobilised subjects they unveil unjust power relations embedded in those socio-technical systems. More significantly, and ever more often, they claim an increasingly active role in their "right to infrastructure" (Jiménez 2014) the ecosystems in which they produce and re-produce and the future(s) they dream of.

References

Authers, J.: Infrastructures: Bridging the gap. Financial Times, 09 November 2015 (2015). http://www.ft.com/cms/s/0/0ac1a45e-86c8-11e5-90de-f44762bf9896.html#axzz4BAfbJc9q. Accessed 14 Oct 2019

Brehmer, M., Lee, B., Bach, B., Riche, N.H., Munzner, T.: Timelines revisited: a design space and considerations for expressive storytelling. IEEE Trans. Vis. Comput. Graph. **23**, 2151–2164 (2017)

Collier, S., Mizes, C., von Schnitzler, A.: Preface: public infrastructures/infrastructural publics. Limn **7**, 2–7 (2016). https://limn.it/articles/preface-public-infrastructures-infrastructural-publics/. Accessed 2 Sept 2017

Jiménez, A.C.: The right to infrastructure: a prototype for open source urbanism. Environ. Planning D: Soc. Space **32**(2), 342–362 (2014)

Crisis-scape.net: Crisis-Scapes: Athens and beyond. Athens: Crisis-scape.net (2014)

Dimitris, D.: Infrastructural gap: Commons, state and anthropology. City **20**(6), 822–831 (2016)

Dalakoglou, D., Agelopoulos, G.: Critical Times in Greece: Anthropological Engagements with the Crisis. Routledge, London (2018)

Dalakoglou, D., Kallianos, Y.: Infrastructural flows, interruptions and stasis in Athens of the crisis. City: Anal. Urban Trends Culture Theory Policy Action **18**(4/5), 526–532 (2014)

Dalakoglou, D., Kallianos, Y.: 'Eating mountains' and 'eating each other': Disjunctive modernization, infrastructural imaginaries and crisis in Greece. Polit. Geogr. **67**, 76–87 (2018)

Filion, P., Keil, R.: Contested infrastructures: tension, inequity and innovation in the global suburb. Urban Policy Res. **35**(1), 7–19 (2016)

Giovanopoulos, C., Dalakoglou, D.: From ruptures to eruption: a genealogy of post-dictatorial revolts in Greece. In: Vradis, A., Dalakoglou, D. (eds.) Revolt and Crisis in Greece: Between a Present yet to Pass and a Future Still to Come. AK Press & Occupied London, London & Athens (2011)

Graham, S., Marvin, S.: Splintering Urbanism: Networked Infrastructures, Technological Mobilities and the Urban Condition. Routledge, London (2001)

Hill, D.: The Battle for the Infrastructure of Everyday Life (2017). https://medium.com/butwhatwasthequestion/the-battle-for-the-infrastructure-of-everyday-life-6c9b0572e57f

Institute of Citizen Studies, University of Geneva: Livewhat - Living with hard times: How citizens react to economic crises and their social and political consequences. Livewhat project, Geneva (2016). http://www.livewhat.unige.ch

Larkin, B.: The politics and poetics of infrastructure. Ann. Rev. Anthropol. **42**, 327–343 (2013)

Lee, B., Riche, N.H., Isenberg, P., Carpendale, S.: More than telling a story: a closer look at the process of transforming data into visually shared stories. IEEE Comput. Graph. Appl. **35**(5), 84–90 (2015)

Linklaters. Set to Revive: Investing in Europe's Infrastructure (2014). https://www.linklaters.com/en/insights/thought-leadership/investing-europe-infrastruture/set-to-revive-investing-in-europes-infrastructure

National Research Council. Infrastructure for the 21st Century: Framework for a Research Agenda. The National Academies Press, Washington, DC (1987). https://doi.org/10.17226/798

ODI (Overseas Development Institute): Infrastructure development: ambition versus reality (2016). https://www.odi.org/opinion/10050-in-fographics-infrastructure-development-ambition-reality

Official Government Gazette: Presidential Decree 39/2011 of the Hellenic Republic concerning the Greek legislation adjustment to the relevant EU Directive EC 2008/114 of the European Council [In Greek] (2011). http://www.kemea.gr/images/documents/pd39-2011.pdf. Accessed 20 Oct 2019

Pasternak, S., Dafnos, T.: How does a settler state secure the circuitry of capital? Environ. Plann. D: Soc. Space **36**(4), 739–757 (2018)

Serntedakis, N., Koufidi, M.: Sygrousiakos kai eklogikos kyklos stin Ellada tis krisis (Conflictual and electoral cycle in crisis ridden Greece). elliniki Epitheorisi Politikis Epistimis **44**(1), 7–30 (2018). http://dx.doi.org/10.12681/hpsa.15919

Star, S.L., Ruhleder, K.: Steps toward an ecology of infrastructure: Design and access for large information spaces. Inf. Syst. Res. **7**(1), 111–134 (1996)